Method Consulting

Intelligent engineering, sustainable buildings

Queensway North, St. Leonards on Sea

M&E Sustainability Statement

Seachange

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Document History

This document has been revised and issued as below:

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P1	05/01/21	Sustainability Statement Preliminary Issue	KDP	BXP

Contents

1 Introduction

This report has been prepared in support of Environmental Impact Assessment for the construction of the Innovation Park, planned for the Queensway, St Leonards, Hastings.

As part of the supporting documentation for the planning application, this report has considered the viability of potential options for onsite renewables and low carbon systems for the development.

In developing this report, reference has been made to the follow; Hastings Local Plan: The Hastings Planning Strategy 2011-2028

2 Planning Policies

This section discusses the relevant policies in the Hastings Local Plan: The Hastings Planning Strategy 2011-2028, and their applicability to the design and construction of the show room and industrial units on The Queensway.

The sections we have been asked to review and expand on are SC3 and SC4, which are as follows:

POLICY SC3: Promoting Sustainable and Green Design
All development must be designed to:
a) incorporate appropriate climate change mitigation and adaptation measures such as green roofs and walls, sustainable drainage systems, multi-functional green space, protecting and enhancing biodiversity, waste reduction and recycling facilities, water efficiency, flood risk management, and the use of recycled materials in new development.
b) enable a low carbon future in a changing climate
Innovative design proposals that enhance and attractively contrast local surroundings will be supported.

POLICY SC4: Working Towards Zero Carbon Development
The energy hierarchy below sets out the most suitable and cost-effective method of achieving low carbon development. Developers are required to follow the hierarchical approach in achieving the energy and carbon dioxide emission requirements of the Building Regulations, for all new residential development. New non-residential development is encouraged to follow the same approach.

1. to improve energy efficiency through thermal and fabric performance improvement measures, then:-
2. provide on-site renewable energy generation or on-site connected heating, or Combined Heat and Power (CHP) technologies, or Combined Cooling, Heat and Power (CCHP) systems then:-
3. the remainder of the CO_2 reduction targets to meet the Building Regulations targets should be met through suitable additional measures such as larger CHP or district heating systems or Mega Watt (MW) scale wind offsetting.

3 Promoting Sustainable and Green Design

3.1 Sustainable Design

There are many measures mentioned in SC3 that can be factored into the projects design, in relation to the building services the most relevant measures are water efficiency, sustainable drainage systems and protecting and enhancing biodiversity.

3.1.1 Drainage

When designing the drainage any extra sustainability measures implemented in the site-wide design will be considered to ensure it is used to its full potential. For more details on the below ground drainage see the Foul and Surface Water Drainage Site Wide (Design Assumptions) layout.

3.1.2 Protecting and Enhancing Biodiversity

Information from environmental consultants will be used to ensure building services do not cause light or noise pollution to a level that would negatively impact the biodiversity of the area.

3.1.3 Water Efficiency

Also, it will be encouraged for the final fittings which will be installed by the tenants to be low flow rate fittings were possible (dual flush toilets, etc.) to minimise water use and improve efficiency.

3.2 Enabling a Low Carbon Future in a Changing Climate

Full details of the low carbon strategies used in this project will be covered in the next section covering SC4. The overall strategy for the project is to enable for low carbon in the future by considering renewable sources in the design and encouraging future tenants to implement low carbon measures and use these features we include in the design and build process to best fit their demands.

4 Energy hierarchy

4.1 Improved Energy Efficiency

The first consideration on energy hierarchy for achieving a low carbon development is through thermal and fabric performance. The design team recognises the importance of a “fabric first” approach in delivering low energy and low carbon buildings and improving the overall performance of the building fabric. To achieve this, we have focused on insulation and air tightness standards, as these minimise heating energy demands.

As this is a new build, we can have insulation and air tightness built into the original designs and as such the following aims will be made to ensure thermal and fabric performance:

- All glazing will be double glazed to improve thermal performance,
- U-Values will be minimised for all cladding panels again to improve thermal performance,
- Good quality of seals on doors and window frames etc. to improve air tightness,

These improvements will help minimise heat loss and cold draughts, whilst at the same time provide a more comfortable indoor environment for the occupants.

To help further increase energy efficiency and work in line with thermal and fabric performance, several energy and water saving strategies have been incorporated into the proposed design for the Queensway North Industrial project, these include:

- High efficiency LED lighting throughout,
- Low water uses sanitary ware such as dual flush WC’s and aerating taps and showers,
- High efficiency combi boilers
- Automatically controlled, energy saving, weather compensated boilers

4.2 Delivering on-site low carbon or renewable energy systems

This section of the report reviews the technologies available and their applicability to the proposed development. The on-site renewable technologies we have considered for the proposed development were:

- Solar hot water
- Ground source heat pumps (GSHP)
- Biomass
- Wind turbines
- Photovoltaics (PV)
- Combined heat and power (CHP)

The following sections describe how each of the above renewable energy technologies work.

4.2.1 Solar hot water

There are two common types of solar collector that are used to provide hot water and space heating in domestic and commercial situations: flat plate collectors and evacuated tube collectors.

In flat plate collectors the working fluid (typically a water/glycol mixture) is directly heated as it circulates through pipework within the collector. The absorber plate and associated pipe work usually sits below a glass cover within a heavily insulated enclosure to reduce heat loss.

Evacuated tube collectors increase the efficiency of the system by enclosing the absorber plate it in a near vacuum. This dramatically reduces the heat loss by convection from the absorber surface. The fabrication of the glass tube is expensive and leads to a collector that will perform better, but at higher cost. Flat plate collectors are generally used on residential buildings and evacuated tube collectors on larger commercial buildings.

The economics and performance of systems have improved since their first deployment over 50 years ago due to the development of the market and improvements in the efficiency of solar collection. The total equipment cost of a solar collector system is usually between £500/m^2 to £1000/m^2 of collector area. The maximum annual requirement which can be satisfied by the solar collector is typically between 50% and 60% of the total annual domestic hot water use.

The installation would be eligible for the Renewable Heat Incentive. The Renewable Heat Incentive is new and financially rewards the producers of green heat for every unit of heat generated. The Renewable Heat Incentive scheme will be very lucrative for green heat producers. The Renewable Heat Incentive effectively subsidises the fuel costs for the first 20 years of operation.

4.2.2 Solar hot water for Queensway North

For Queensway North, solar hot water collectors offer the following advantages:

- Solar hot water collectors can prove to be an effective means to generate hot water particularly for domestic properties
- There is a large amount of roof space with a slight pitch and although no roofs are directly south facing, they all have at least some south-east or south west orientated roof space,

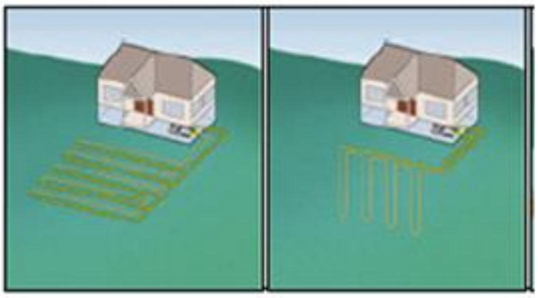
For Queensway North, we have considered the use of solar hot water collectors however for the following reasons, they have been discounted:

- Unlikely to offset sufficient carbon dioxide emissions, especially with estimated low hot water demand,
- Traditional gas boilers would still be required to generate heat for heating and any shortfall in heat for hot water,

Conclusions for Queensway North:

- Discounted, primarily for the lack of hot water demand for this development and the more effective use of space for photovoltaic panels.

4.2.3 Ground source heat pumps



Horizontal Array Vertical Boreholes

A heat pump uses the same 'vapour compression' technology that is used in a domestic refrigerator, however the cycle can be reversed so can be used for both heating and cooling the internal space. As suggested by the name a heat pump uses electricity to transfer heat from one source to another rather than actually generate energy, with most of the energy coming from the ambient temperature of the ground or water to which it is connected. The coefficient of performance (COP) is the ratio of the heat output to the electricity input. With most modern equipment the COP will typically range from 2 to 4, i.e. for 1kW of electrical input up to 4kWs of heating or cooling can be achieved.

It should be noted that due to similar CO_2 emissions associated with the grid electricity supply and natural gas, COPs must be better than 2.5 before there is any reduction in CO_2 emissions compared to heating via gas or gas fired condensing boilers. However, if the electricity is generated from renewable energy sources then heat pumps can be part of a carbon neutral servicing strategy of providing both heating and cooling to buildings.

Heat pumps are characterised depending on the source of the heat and the sink used for the heat. In the heating mode, energy can be extracted from the air, water or from the ground and delivered to the space via fan powered air supply or a water circuit (usually underfloor heating).

Air source heat pumps have the disadvantage of extremely variable temperature conditions throughout the year. As a result, they have coefficients of performance of around 2.5. Ground source heat pumps have the advantage that the source remains at a relatively constant temperature throughout the year and this gives good conditions for high performance, so typically COPs are between 3 and 4.

Maintenance requirements for a GSHP are similar to those of a gas or oil boiler.

4.2.4 Ground source heat pumps for Queensway North

For Queensway North, ground source heat pumps offer the following advantages:

- It is an efficient heat source,
- It would qualify for the Renewable Heat Incentive,

For Queensway North, we have considered the use of ground source heat pumps however for the following reasons, they have been discounted:

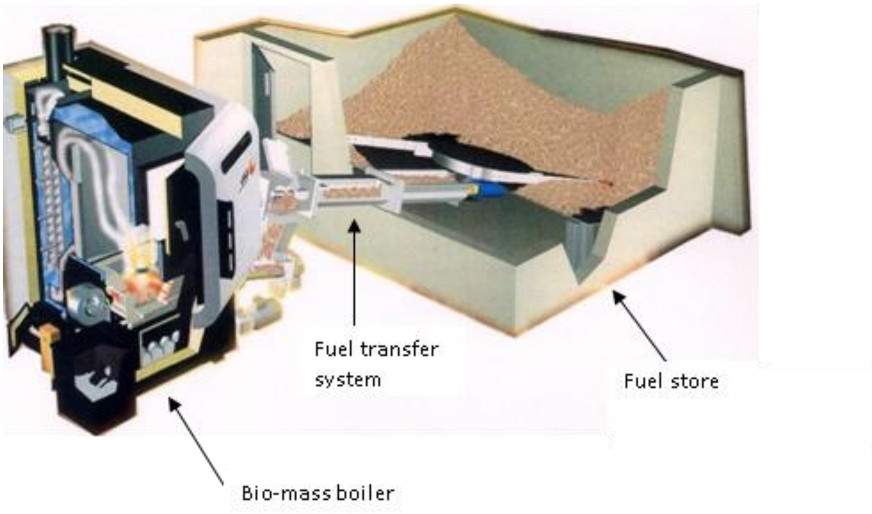
- Significant external space is required in order to accommodate the boreholes (often drilled to a depth of 125m) or horizontal slinky array,
- Concerns of the increased risks encountered when digging or drilling into the ground, especially in an area with challenging ground conditions,

- GSHPs work best when coupled with underfloor heating. Unfortunately, the industrial nature of the buildings means heavy loads may need to be placed on the floors, or there may be machinery which would be adversely affected by being heated from below in this way, therefore under floor heating isn't feasible, which makes a GSHP much less feasible,
- Cost: GSHPs are very expensive meaning that the entire feasibility of the project would be in question if this option were to be pursued.
- This technology is not considered viable for the scheme due to the high cost of the number of boreholes that would be required and constraints of the local geology.

4.2.5 Biomass

Biomass refers to burning natural, vegetative matter to produce heat. This heat can be used both to temper the building, and to meet the hot water requirements. The fuel used for the boiler is typically wood, which comes in the form of either chips or pellets. The CO_2 released when burning this matter is equivalent to the CO_2 the trees have absorbed in their lifetime. Thus, the whole process becomes almost carbon neutral. The only additional emissions will be from processing and transportation of the fuel to the site.

Biomass, like any solid fuel, requires storage on site, and to minimise the frequency of deliveries, significant space needs to be allowed for storage of fuel on site and associated access for delivery. Wood pellets have a higher energy density and more consistent size, shape and moisture content so are better suited to smaller boiler installations and where fuel delivery access is restricted.



Currently the cost of woodchips is slightly cheaper than the cost of natural gas, whereas the cost of wood pellets is similar to that of gas. However, the price of natural gas and gas has been very volatile in recent years and for many customers has doubled in price since 2002. In contrast the price of wood fuel has been much more stable, and that is likely to remain the case in the medium to long term.

4.2.6 Biomass for Queensway North

For Queensway North, biomass boilers offer the following advantages:

- It is an efficient heat source,
- It would qualify for the Renewable Heat Incentive,

For Queensway North, we have considered the use of biomass boilers however for the following reasons, they have been discounted:

- Significant additional plant space will be required,
- There are concerns of delivery of fuel through an urban environment,
- Smoke control – normally the flue must rise at least 1m above the building, including neighbouring buildings,
- Traditional fossil fuel back-up boiler plant would also be required to provide robustness in heat supply (biomass boilers are inherently less reliable than traditional gas boilers as they must transport a solid fuel and ash residue).

4.2.7 Wind turbines

Wind turbines use energy from the wind to produce electricity. This electricity can be used on site or sold back to the national grid. The suitability of installing wind turbines is largely dependent on local wind speeds. Accurately estimating the energy available from wind at a specific site is a complex task and requires knowledge of the long-term wind speeds at height, considering climatic variations, the effect of topological features and ground friction factors. Average wind speeds of 7 m/s or above are required for large scale wind turbines, although average speeds in the region of 4-6m/s can be sufficient to make smaller turbines viable.

Turbines are rated by the power generated at a specific wind speed. At very low wind speeds turbines do not operate. When they reach their critical cut-in wind speed they generate at a lower level than the rating, and finally once the rated wind speed is reached the turbine is designed to maintain a fairly constant power output. As a turbine is not generating all of the time, and sometimes at part load, a good approximation of annual output is 20-30% of that expected if the turbine was operating continuously at its rated level throughout the year. This percentage is known as the capacity factor.

Costs for grid-connected wind turbines are highly dependent on the size of turbine specified, site specific installation costs and grid connection costs. Small wind turbines (<10kW) might cost as much as £5,000 per kW installed whereas for larger turbines (> 500kW) the cost will be closer to £1,000 per kW installed.

Running costs for wind turbines are low compared with initial capital cost. Annual maintenance and insurance costs are typically in the range 2 – 3 % of the initial capital investment.

A common misconception is that wind turbines are noisy due to mechanical noise and aerodynamic noise. A conversation can be held without difficulty when standing directly below a 3MW turbine. However, typically the closest that large turbines are sited to existing homes is at a distance of between 400 metres and 600 metres to reach a range where the turbines are barely audible, with normal background noise masking that of the turbine.

4.2.8 *Wind turbines for Queensway North*

For Queensway North, wind turbines offer the following advantages:

- Wind turbines, can prove to be an effective means to generate electricity particularly for industrial parks,

For Queensway North, wind turbines offer the following disadvantages:

- Surrounding urban environment and low altitude makes the proposed development site unsuitable,
- In-sufficient land space for their installation and on-going maintenance,
- Given the urban environment which adjoins the site, noise considerations are significant,
- The Feed-in Tariff subsidy scheme has now ended meaning there are no capital or revenue-based subsidies available

Conclusions for Queensway North:

- On balance, due to space available and considerations of the surroundings, this solution has been discounted.

4.2.9 Photovoltaics

Solar energy can be converted to electricity using the photo-electric effect. Simply, Photo Voltaic (PV) cells use the energy from the sun to induce a current in a circuit. The cells are encapsulated between a sheet of toughened glass at the front and a moisture sealing membrane on the back to make them weatherproof.

In the UK PV panels are usually installed on roofs of buildings. The optimum position is facing south with a tilt angle of around 30°. PV is potentially the easiest of all renewable energy technologies to embed into the built environment.

PV modules are rated by their output in standard test conditions, which is approximately equivalent to the solar radiation available on a clear summer day at noon. This output is referred to as the rated peak power, or by Wp (peak Watts).

The total area of an array for a rated power is dependent on the technology used. For a 1kWp array this would range from 6.0 to 7.0m2 for commonly used polycrystalline modules.

As a general rule of thumb, for every kWp of PV installed facing near south (southeast to southwest) with a tilt angle of 30 - 60 deg, the annual output will be in the region of 850kWh per year.

PV installations have a limited life of approximately 20 years. However during its life a PV system needs very little maintenance. In all but exceptional cases modules are self-cleaning with rainfall.

Costs of PV systems depend on the PV module and the method of installation. For domestic/small installations roof mounted on a frame, the complete cost (equipment, installation, and permissions) would be in the region of £1,000 - £1,500 per kW installed. Specialist modules that replace conventional roof tiles are currently more expensive and these systems cost in the region of £2,000 - £3,000 per kW installed. For large installations of 20 kW plus, the cost of the system would be lower.

4.2.10 Photovoltaics for Queensway North

For Queensway North, photovoltaic panels offer the following advantages:

- PV panels can prove to be an effective means to generate electricity particularly for domestic properties

- The building has a pitched roof on which the collectors could be mounted, and all roofs have favourable orientations, that allow for panels facing between south-east and south-west,
- Being that these are industrial units, the visual impact of the panels is negligible.

For Queensway North, we have considered the use of Photovoltaics however there are the following drawbacks:

- Traditional gas boilers would still be required to generate heat for heating and heat for hot water
- The Feed-in Tariff subsidy scheme has now ended meaning there are no capital or revenue-based subsidies available

Depending on the end use the electrical demand of these buildings be not be very high meaning that generated electricity may need to be exported to the grid which provides little financial gain with current electricity export prices

Conclusions for Queensway North

- Photovoltaics are probably one of the most appropriate ways to reduce the carbon impact of the site's electrical demands and despite some small drawbacks are worthwhile,
- The building structure has been designed to account for the instillation of PV panels on each of the units roofs, to encourage their use by future tenants.

4.2.11 Combined heat & power

Combined Heat and Power (CHP) machines are in effect mini power stations. When a power station burns gas, coal or gas to generate electricity, large amounts of heat is given off as a by-product. Large power stations waste this heat (via large cooling towers – it is simply emitted to atmosphere). A CHP unit aims to make use of this waste heat by putting it into a hot water cylinder or heating system when it generates electricity. The electricity can either be used within the building or sold back to the national grid if output exceeds demand.

A 5.5kWe output and 12.5t CHP Machine

CHP machines work best when there is an all year round heat demand. A good example would be a large leisure centre with a heated swimming pool or a large community of houses or flats. Sizing CHP machines can also be very complex; unlike modern gas and gas boilers which can modulate down to exactly match the heat demand, CHP machines do not modulate so readily. This means that they are either on or off and can be generating large amounts of heat when there simply isn't a demand for it and so gets wasted or dumped.

Whilst the summer hot water demands are likely to be fairly minimal, it does not mean that the CHP machine will not be viable; it simply means that it will operate during the winter when there is both a heat and electrical demand. In other words, in order to maximise carbon dioxide emission savings it would be beneficial to set the CHP engine to be thermal lead instead of electricity lead.

In order to maximise the benefit from the installation whilst minimise the capital cost, a small engine (costing circa £25,000) constantly used would be a better solution than a large engine infrequently used. Gas boilers would supplement heat output when required. The CHP engine would have a simple payback period of around 10 years. No grant funding is available for this technology.

The building could be connected to both the national grid meaning that any spare electricity generated (and not used by the building) could be exported to the national grid via an import/export meter would not be required. Unfortunately, it is not possible to export any spare heat generated by this technology to any neighbouring buildings.

4.2.12 *Combined heat & power for Queensway North*

For Queensway North, combined heat and power engines offer the following advantages:

- Instead of producing either heat or electricity, a CHP could prove an effective means of generating both for use on site,
- Any excess electricity produced while heat is being generated can be exported to the national grid.

For Queensway North, combined heat and power has been discounted for the following reasons:

- There are no known resellers of domestic CHP engines in the UK meaning that obtaining parts and competent technicians to undertake servicing is likely to be very problematic and expensive,
- The CO_2 reductions from a CHP system decrease as we move towards a cleaner electricity grid, this doesn't fit with the aim of being adaptable to the changing climate as mentioned SC3 and would also inherently never be a zero-carbon technology due to its reliance on gas,
- The Feed-in Tariff subsidy scheme has now ended meaning there are no capital or revenue-based subsidies available,
- For this application where there is not a constant heat demand, the CHP would likely not be used for the summer months, especially as hot water demand is not likely to be high in this development,
- However due to a lack of space for a separate large boiler house, individual combi boilers within each unit were deemed the most appropriate and cost-effective solution,

Conclusions for Queensway North:

- This solution has been discounted due to the limited scale of opportunity, unpredictability of how the tenants use the units and limited space available.

4.3 Delivering carbon reductions through good system design

4.3.1 *Scope*

The possible heating strategy for the Queensway North units will adopt a highly efficient gas combi boiler heating system, therefore eliminating the need for hot water storage and the associated standing heat loss from the cylinder. This approach ensures that the scheme delivers optimum efficiency, whilst minimising the emissions of pollutants, such as carbon dioxide emissions and nitrous oxide emissions, into the local environment and atmosphere.

5 Summary

This document confirms that the Queensway North site will be designed to be as energy efficient as practical i.e. “lean” in terms of energy consumption with all stages of the design considered, from the insulation and glazing, to the many possible renewable technologies available.

The designs also incorporates “clean” technologies by including highly efficient gas combi boilers which eliminate standing heat loss from hot water cylinders (as opposed to electric or oil heating).

As discussed, various energy systems have been explored to make the development as sustainable as possible whilst working within the limitations which come with the space requirements, surroundings, and unpredictability of the project. However, without being aware of what the exact uses of these units will be, instillation of specific technologies has been left up to the tenants, with the initial design considerations being used to make renewables as feasible and attractive to the future tenants as possible.

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